REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claim 26 to recite that each of the plurality of anode plates has an anode planar shape, and that each of the plurality of first electrically conductive current-collecting plates has substantially a same planar shape as the anode planar shape of each of the plurality of anode plates. Applicants have further amended claim 26 to recite that the plurality of first and second electrically conductive current-collecting plates cover all of the plurality of "anode plates" and all of the plurality of "cathode plates", respectively; and to recite that the first and second electrically conductive current-collecting plates are electrically connected through the slots of the electrolyte membrane. Claim 27 has also been amended to recite "anode plates" and "cathode plates". In addition, claim 28 has been amended to recite that the electrolyte membrane is a single electrolyte member having the slots therethrough; and claim 29 has been amended to recite that the slots in the single electrolyte membrane are a plurality of slots through the single electrolyte membrane.

Furthermore, noting that claim 1 has previously been cancelled without prejudice or disclaimer, withdrawn claim 9 has been amended to recite a fuel assembly having the sheet chemical cell of claim 26.

In addition, Applicants are adding new claims 32-37 to the application. Claim 32, dependent on claim 26, recites that adjacent cathode plates and adjacent anode plates form first and second pairs; and further recites that a first electrically conductive current-collecting plate, of the plurality of first electrically conductive current-collecting plates, covering the one of the plurality of anode plates, is electrically connected with a second electrically conductive current-collecting plate,

of the plurality of second electrically conductive current-collecting plate, covering the adjacent cathode plate, through a slot between the one of the plurality of cathode plates and the adjacent cathode plates. Claim 33, dependent on claim 26, recites that each of the plurality of cathode plates has a cathode planar shape, with each of the plurality of second electrically conductive current-collecting plate having substantially a same planar shape as the cathode planar shape of the plurality of cathode plates; and claim 34 recites the same subject matter expressly set forth in claim 32, but is dependent on claim 33. Claim 35, dependent on claim 26, recites matching of first electrically conductive current-collecting plates with anode plates, and matching second electrically conductive current-collecting plates with cathode plates. Claims 36 and 37, dependent respectively on claims 26 and 36, respectively recites that the electrically conductive current-collecting plates include a copper layer; and recites that the electrically conductive current-collecting plates furether include a gold or platinum layer on the copper layer.

In connection with the newly added claims, note, for example, pages 17-19 of Applicants' specification.

Applicants respectfully traverse the rejection of their claims under the first paragraph of 35 U.S.C. §112, as failing to comply with the written description requirement, set forth in Item 4 on page 3 of the Office Action mailed April 5, 2007, especially insofar as this rejection is applicable to the claims as presently amended.

Thus, the Examiner contends that the material not supported by the original disclosure is the language in claim 26 of a plurality of anode plates and a plurality of cathode plates. However, the attention of the Examiner is respectfully directed to page 6, lines 15-24 of Applicants' original specification, describing a sheet-like chemical cell including a plurality of unit cells which comprise an electrolyte

membrane, "a plurality of anode plates which oxidizes fuel on one surface of said electrolyte membrane, and a plurality of cathode plates which reduces oxygen on the other surface of said electrolyte membrane with said anode and cathode plates opposed each other in pairs with the membrane therebetween". Note also, illustratively and not to be limiting, the paragraph bridging pages 13 and 14 of Applicants' specification, disclosing a plurality of electrode plates 2 formed on each surface of a single electrolyte membrane 1, this description going on to set forth that the electrolyte membrane 1 has a plurality of cathode plates 3 that reduces oxygen on one surface of said electrolyte membrane 1 and a plurality of anode plates 4 which oxidizes fuel on the other surface of said electrolyte membrane. Clearly, there is a description in Applicants' specification of a plurality of anode plates, and a plurality of cathode plates.

Additionally, and to be illustrative and not limiting, attention is respectfully directed to Figs. 2, 4, 5 and 6, together with the description in Applicants' specification in connection therewith. Note pages 13-20 of Applicants' specification. It is respectfully submitted that this description provides a disclosure, sufficient to satisfy the description requirement of the first paragraph of 35 U.S.C. §112, of the plurality of anode plates and the plurality of cathode plates.

The contention by the Examiner in Item 4 on page 3 of the Office Action mailed April 5, 2007, that a point that needs attention is that pages 18 and 19 disclose the formation of anode/cathode wiring layers 15, 12, is noted. As is clear from Applicants disclosure as a whole, and as seen in the foregoing, reference characters 3 and 4 respectively illustratively represent the plurality of cathode plates and the plurality of anode plates. The wiring layers 15, 12 illustratively correspond to the first and second electrically conductive current-collecting plates of the present

claims, not the anode plates and cathode plates. It is respectfully submitted that this can clearly be seen, for example, in Fig. 6, which shows anode plate 4 and cathode plate 3, and additionally shows the anode and cathode wiring layers 15 and 12, respectively.

Thus, as is clear from the foregoing, it is respectfully submitted that there is clear support for the plurality of anode plates and the plurality of cathode plates, illustratively, represented by reference characters 4 and 3 in, e.g., Fig. 6, as well as a full description of the electrically conductive current-conducting plates. Accordingly, it is respectfully submitted that the rejection under the first paragraph of 35 U.S.C. §112, is in error, and should be withdrawn.

The requirement by Applicant to cancel "the new matter" is noted. While the Examiner has rejected claim 26 under the first paragraph under 35 U.S.C. §112, as containing "added material which is not supported by the original disclosure", the Examiner has not indicated new matter. See 35 U.S.C. §132. In any event, as seen in the foregoing, there is a full description of a plurality of anode plates and a plurality of cathode plates in Applicants' original disclosure, so that clearly recitation of the plurality of anode plates and the plurality of cathode plates does not constitute new matter.

Applicants respectfully traverse the rejection of their claims under the second paragraph of 35 U.S.C. §112, as being indefinite, for reasons set forth in Items 7-12 on pages 4 and 5 of the Office Action mailed April 5, 2007, especially insofar as this rejection is applicable to the claims as presently amended. Thus, Applicants have amended claims 26 and 27 to recite "anode plates" and "cathode plates". It is respectfully submitted that there is clear antecedent basis for such "plates" in claim 26.

Applicants have also amended claim 26, in lines 8 and 9, to recite the "plurality of" first electrically conductive current-collecting plates and the "plurality of" second electrically conductive current-collecting plates; it is respectfully submitted that there is clear antecedent basis for these recitations, in claim 26.

Applicants have amended the language objected to in Item 10 on page 4 of the Office Action mailed April 5, 2007, reciting that the first and second electrically conductive current-collecting plates are electrically connected through the slots of the electrolyte membrane. It is respectfully submitted that such recitation as to the electrical connection is sufficiently definite such that one of ordinary skill in the art would know whether any specific sheet chemical cell fell within or outside the scope of such claim. Under the present circumstances, the second paragraph of 35 U.S.C. §112, requires nothing more. See In re Moore, 169 USPQ 236 (CCPA 1971).

Applicants respectfully traverse the rejection of claim 26 under the second paragraph of 35 U.S.C. §112, as being incomplete, insofar as this rejection is applicable to the claims as presently amended. It is respectfully submitted that the present claims recite sufficient components, especially in light of, for example, Figs. 5 and 6 of Applicants' original disclosure, including structural cooperative relationships, so as to recite the structural components and structurally cooperative relationships therebetween.

In view of amendments to claims 28 and 29, it is respectfully submitted that the basis for rejection thereof, set forth in Item 15 on page 12 of the Office Action mailed April 5, 2007, is moot.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed

April 5, 2007, that is, the teachings of the U.S. patent documents of Choi, Patent No. 6,689,502, to Kidai, et al, Patent Application Publication No. 2005/0074651, and to Lawrence, et al, Patent Application Publication No. 2004/0013927, under the provisions of 35 U.S.C. §102 and 35 U.S.C. §103.

It is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a sheet chemical cell as in the present claims, having the electrolyte membrane with slots, and plurality of anode plates and plurality of cathode plates, each of the plurality of cathode plates constituting a pair with a respective anode plate of the plurality of anode plates, and wherein the sheet chemical cell additionally has a plurality of first and second electrically conductive current-collecting plates respectively covering all of the plurality of anode plates and all of the plurality of cathode plates, each of the plurality of first electrically conductive current-collecting plates having substantially a same planar shape as the anode planar shape of each of the plurality of anode plates, with the first and second electrically conductive current-collecting plates being electrically connected through the slots of the electrolyte membrane. See claim 26.

As will be shown in the following, it is respectfully submitted that the teachings of the applied references do not disclose, nor would have suggested, the electrically conductive current-collecting plates including wherein each of the first electrically conductive current-collecting plates have substantially a same planar shape as the anode planar shape of the anode plates, providing improved current conduction due to the size of the current-collecting plates.

Furthermore, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a sheet chemical cell as in the present claims, having features as discussed previously in

connection with claim 26, and, moreover (but not limited to), wherein each of the plurality of anode plates has one first electrically conductive current-collecting plate, of the plurality of first electrically conductive current-collecting plates, covering thereon, and each of the plurality of cathode plates having one second electrically conductive current-collecting plate, of the plurality of second electrically conductive current-collecting plates, covering thereon (see claim 27); and/or wherein a first electrically conductive current-collecting plate, of the plurality of first electrically conductive current-collecting plates, is matched with an anode plate, of the plurality of anode plates and a second electrically conductive current-collecting plate, of the plurality of second electrically conductive current-collecting plates, is matched with a cathode plate, of the plurality of cathode plates (see claim 35); and/or wherein each of the plurality of second electrically conductive current-collecting plates has a substantially same planar shape as that of each of the plurality of cathode plates (see claim 33); and/or wherein the plurality of first and second electrically conductive current-collecting plates each include a copper layer (see claim 36), and additionally include a gold or platinum layer on the copper layer (see claim 37).

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such sheet chemical cell as in the present claims, having features as discussed previously in connection with claim 26, and having additional features as in the remaining dependent claims, including positioning of the slots as in claims 20, 21 and 32; and/or wherein the slots are filled with an insulating sealant (see claim 15); and/or wherein not every slot is used for electrical connection, as in claims 22 and 23; and/or wherein the electrolyte membrane is a single membrane having the slots therethrough, as in claim 28, in particular having a plurality of slots therethrough (see

claim 29), particularly wherein the single electrolyte membrane is a continuous membrane (see claim 30; note also claim 31); and/or wherein the cell further includes a plastic sheet as a cover of the sheet chemical cell (see claim 17), with the electrically conductive current-collecting plates and the plastic sheet being provided with through-holes through which fuel and oxygen are supplied (see claim 18).

The present invention relates to a sheet chemical cell, particularly useful, for example, in fuel cells such as a direct methanol fuel cell (DMFC) using methanol and water as fuel, or a polymer electrolyte fuel cell (PEFC).

There have been attempts to develop smaller power generators that need no recharging, e.g., as power sources for recent electronic devices such as mobile telephone sets, book-type personal computers, audiovisual equipment and mobile information terminal equipment. As one of such power generators meeting requirements of small size, and a power supply of higher energy density and of longer running periods (in particular, that need no recharging), a fuel cell power supply has been discussed.

Types of fuel cells being proposed for power supplies for electronic devices discussed in the foregoing include polymer electrolyte fuel cells and direct methanol fuel cells. Direct methanol fuel cells show promise as oxygen is supplied to the outer surfaces of a cathode, in contact with outside air, so that this type of power generation device does not require any auxiliary machine to supply the fuel and the oxidizing agent, simplifying the fuel cell system. However, each individual cell of the direct methanol fuel cell has a very low output voltage, e.g., 0.3-0.4V; therefore, to generate an output voltage to power portable electronic devices, the unit cells must be connected in series. As described in the last paragraph on page 5 of Applicants'

specification, these unit cells are serially connected in the anode-to-cathode manner to generate a voltage for powering the portable electronic equipment.

However, previously proposed fuel cells having such series connection are very complicated to manufacture, and the manufacturing method is time-consuming, because the unit cells must be electrically connected in series. As can be appreciated, as the number of units cells to be connected increases, the problem becomes more severe. Furthermore, each unit cell must be sealed to prevent leaks, which limits the energy density of the cell.

Moreover, with previously disclosed fuel cells, electrical connection between adjacent anodes and cathodes is by way of an electrical connection (a wire connection) having a small contact area with the anode and cathode.

As well known, a resistance of electrodes of fuel cells in the lateral direction is quite large because the electrodes are composed of a catalytic metal, carbon powder and a resin binder, while a specific resistance of electrodes in a thickness direction is not large because of a very small thickness. Accordingly, if an area of the collector in contact with the electrode is small, sufficient electricity would not be taken out from the fuel cell, due to high resistance between the collector and the electrode.

Against this background, Applicants provide a sheet chemical cell which is simple and easy to fabricate, providing unit cells which can be connected in series so as to achieve sufficient output voltage, in which undesirable ion flow between adjoining two electrodes (e.g., adjoining cathodes, or adjoining anodes) is avoided, and wherein electricity can easily and effectively be taken out of the fuel cell. In particular, Applicants provide structure wherein each of the plurality of first electrically conductive current-collecting plates has substantially a same planar

shape as the anode planar shape of each of the plurality of anode plates, and the electrically conductive current-collecting plates cover the plurality of anode plates. Moreover, according to the present invention, each current-collecting plate is made of, e.g., copper, having a very small electrical resistance in the lateral direction; for example, a specific resistance of catalyst layer of an anode or a cathode in the lateral direction is on the order of 1×10^{-1} Ω - cm, while a specific resistance of a copper collector in the lateral direction is on the order of 1×10^{-6} Ω - cm. According to the present invention, the collector covers the surface of the electrode, having substantially the same shape "lateral area" as the electrode, and, therefore, electrical resistance between the anode (or cathode) and the collector becomes very small.

Moreover, the cells according to the present invention can have a relatively small thickness. Applicants have found that by providing the electrolyte membrane with slots, e.g., as a single, continuous membrane having a plurality of slots, and with electrically conductive first and second current-collecting plates being respectively formed on the anodes and cathodes, and being connected with each other through these slots formed in the electrolyte membrane, the structure can be manufactured by simple and efficient processing steps, providing a structure which has a relatively small thickness.

By sealing these slots with an insulating material, leakage through the membrane can be avoided.

In addition, by providing the slots, in particular between adjacent anodes and cathodes (in claim 21, between every two adjoining anodes, and between every two adjoining cathodes), short circuiting between adjacent electrodes due to ion flow therebetween can be avoided. See, e.g., page 16, lines 12-14, of Applicants' specification.

As described in the first two paragraphs on page 8 of Applicants' specification, the unit cells are electrically connected to output desired high voltages and currents, and fuel cells utilizing the sheet chemical cells of the present invention can run portable electronic equipment as referred to on page 8 of Applicants' specification. As for advantages achieved by the present invention, note, for example, the sole full paragraph on page 22, and the paragraph bridging pages 22 and 23, of Applicants' specification.

Choi discloses a cell pack of a direct methanol fuel cell, having structure described most generally in the paragraph bridging columns 2 and 3 of this patent. This patent discloses that the cell includes upper and lower plates spaced a predetermined distance apart from each other, with an ion exchange membrane provided therebetween, a plurality of first anodes installed in each single cell region on the first surface of the membrane and a plurality of first cathodes disposed in each single cell region adjacent to each of the anodes, a plurality of second cathodes installed in each single cell region on a second surface of the ion exchange membrane corresponding to the first anodes, and a plurality of second anodes corresponding to the first cathodes, first and second anodes current collectors installed on the first and second anodes and each having a fuel passage region, first and second cathode current collectors installed on the first and second cathodes, with a plurality of first conductive portions electrically connecting the first anode and cathode adjacent to each other on the first surface of the ion exchange membrane and a plurality of second conductive portions electrically connecting the second anode and cathode adjacent to each other on the second surface of the ion exchange membrane to electrically connect in series cells provided in the single cell region. Note also, for example, column 5, lines 29-34 of Choi.

As a background to Choi, this patent discloses in Fig. 3 a conventional monopolar cell pack having some parts of single cells being disposed in a row so as to overlap with neighboring cells, cathodes 13 and 13a of the respective cells being electrically connected in series to an anode 12a of a cell next thereto by current collectors 14 and 14a. Between the anode 12, 12a, etc. and the cathode 13, 13a, etc. of respective unit cells are structure 11, 11a, 11b, etc. (which appears not to be described in Choi and would appear to be overlapping individual membranes). In connection with Fig. 3, note column 2, lines 39-52 of Choi.

It is respectfully submitted that the first conductive portion 141 and second conductive portion 142 in Choi are connected with very small portions of electrode. Note, e.g., Figs. 2A, 4, 5 and 6 of Choi. It is respectfully submitted that this is recognized by the Examiner, in construing Choi as describing a connection wire connecting anode to cathode of neighboring cells. It is respectfully submitted that Choi does not disclose, nor would have suggested, the first and second current-collecting plates as in the present claims, covering the anode plates and cathode plates, respectively, and with each of the first electrically conductive current-conducting plates having substantially a same planar shape as the anode planar shape (see claim 26), and the second electrically conductive current-collecting plates having substantially a same planar shape as the cathode planar shape (see claim 33), and advantages thereof as discussed in the foregoing.

Moreover, it is respectfully submitted that Choi in Fig. 3 has individual membranes 11, 11a, 11b, etc., with current collectors passing between the individual membranes, which overlap each other. It is respectfully submitted that this structure as in Fig. 3 of Choi would have neither disclosed nor would have suggested, and in fact would have taught away from, the presently claimed structure, including an

electrolyte membrane having slots, a single or continuous electrolyte membrane having the slots (in particular, a plurality of the slots), or the combination of the slots and the plurality of first electrically conductive current-collecting plates covering all of the plurality of anodes and the plurality of second electrically conductive current-collecting plates covering all of the plurality of cathodes, and advantages thereof as in the present invention.

The contention by the Examiner in Item 14 on page 6 of the Office Action mailed April 5, 2007, that the support layers may serve as the plurality of wiring plates covering respective anode/cathodes is respectfully traversed. Initially, it is not a question of what the structure may do, but rather what the references disclose or would have suggested. Moreover, Choi discloses the support layer as part of the anode and as part of the cathode. It is respectfully submitted that Choi does not disclose support layers corresponding to the current-collecting plates of the present claims, additional to the anode plates and cathode plates.

Moreover, it is noted that in column 1, Choi discloses carbon paper or carbon cloth as the support layers, especially teaching away from the structure of claims 36 and 37.

Furthermore, it is again emphasized that Choi discloses a plurality of membranes, teaching away from the relatively simple structure of the presently claimed sheet chemical cell having an electrolyte membrane, particularly a single electrolyte membrane, which is a continuous membrane, as in various of the present claims.

It is respectfully submitted that the additional teachings of the secondary references as applied by the Examiner would not have rectified the deficiencies of

Choi, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Kidai, et al discloses a polymer electrolyte membrane and a polymer electrolyte fuel cell using such membrane. The membrane is filled with a proton conductor in the collimated pores of a polymer film equipped with a plurality of these collimated pores in the vertical direction, and is characterized with a relative standard deviation (LVar/LAve) equal to or below 0.3, wherein LAve and LVar represent an average value of L distances between centers of the adjacent collimated pores and the standard deviation thereof, respectively. Note especially paragraph [0015] on page 2 of this patent publication. Note also paragraphs [0056], [0058], [0059], and [0061] on page 5 of this patent publication. Note also paragraph [0064] bridging pages 5 and 6 of this patent publication. See also paragraphs [0085] and [0086] on page 8 of this patent publication.

The Examiner has relied on Fig. 6 of this patent publication, especially the lowermost figure of Fig. 6. Fig. 6 is described, e.g., in paragraph [0054] on page 4, and paragraph [0141] on page 11, of this patent publication. Shown in the lower-most figure of Fig. 6 are reference characters 7, which constitute electrodes of the cell.

It is respectfully emphasized that Kidai, et al. depicts a polymer electrolyte membrane comprising a plurality of electrodes 7 consisting of respective electrode substrate and electrocatalyst layers. Note paragraph [0058] on page 5 of this patent publication. The electric connection between the anodes and cathodes located on opposite sides of the membrane is formed by electron conducting area 5. Note paragraphs [0056] through [0058] of this patent publication.

In Kidai, et al., it is respectfully submitted that the electrodes 7 are shown exposed, and are not covered with current-collecting plates, as in the present claims.

Moreover, it is respectfully submitted that Kidai, et al. does not disclose, nor would have suggested, slots in the electrolyte membrane, much less the combination of slots and current-collecting plates, providing advantages in simplicity of manufacture and effectiveness of the cell of the present invention, as discussed previously.

Furthermore, again noting the shape of the plurality of first electrically conductive current-collecting plates as in claim 26, and the plurality of second electrically-conductive current-collecting plates as in claim 33, it is respectfully submitted that the combined teachings of Choi and of Kidai, et al, would have neither disclosed nor would have suggested such shape, and advantages achieved thereby in efficient and effective conduction of current.

In addition, Applicants respectfully traverse the analysis by the Examiner in connection with claims 22 and 23, i.e., that Kidai, et al discloses not every slot being used for electrical connection. In this regard, it is respectfully submitted that openings in the structure of Kidai, et al, having conductors passing therethrough are used for electrical connection, and the basis given by the Examiner that not every slot is used for electrical connection is not seen.

Lawrence, et al discloses a fuel assembly for portable electronic devices, having a membrane electrode assembly, a removable fuel cartridge and a fuel delivery system. A removable fuel cartridge includes an expandable fuel bladder for receiving liquid fuel, and an expandable pressure membrane contact with the bladder for maintaining a positive pressure on the bladder. See paragraph [0013] on page 1 of this patent document. Paragraph [0087] in column 6 discloses that the

expandable fuel bladder is formed of a sheet plastic material and/or other polymer material substantially impervious to methanol. Note also paragraph [0106] on page 7 of this published application.

Even assuming, arguendo, that the teachings of Lawrence, et al were properly combinable with the teachings of Choi, such combined teachings would have neither disclosed nor would have suggested the electrically conductive current-collecting plates, having shapes as in the present claims, and advantages thereof.

Moreover, it is noted that Lawrence, et al. discloses a fuel bladder of the plastic material. It is respectfully submitted that disclosure of such fuel bladder as in Lawrence, et al, would have neither disclosed nor would have suggested a plastic sheet as a cover of the sheet chemical cell as in claim 17, much less wherein such plastic sheet is provided with through-holes through which fuel and oxygen are supplied, as in claim 18.

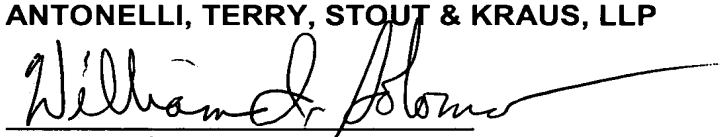
In view of the foregoing comments and amendments, reconsideration and allowance of all claims being considered on the merits in the above-identified application, are respectfully requested.

Applicants request any shortage in fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP,

Deposit Account No. 01-2135 (case 520.43227X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



William I. Solomon
Registration No. 28,565

WIS/kmh
1300 N. 17th Street, Suite 1800
Arlington, Virginia 22209
Tel: 703-312-6600
Fax: 703-312-6666